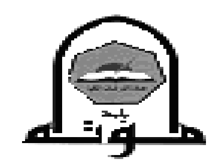


Mu'tah University

Deanship of Graduate Studies

Epidemiological Patterns of Metabolic Syndrome among Type 2 Diabetes in Alkarak Population, South Jordan

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الاراء الواردة في الرسالة الجامعية لا تعبر

بالضرورة عن وجهة نظر جامعة مؤته

DEDICATION

To My Beloved Husband, My Daughters and Sons, My Mother and Father, Sisters, to My Son Rami and My Sister Samar Salahat.

Eman Ali Mowafi

ACKNOWLEDGEMENT

Alhamdulillah, I am grateful to Allah S.W.T. who gave me the strength and courage to complete this study. I would like to express much gratitude and sincere thanks to my Supervisor, Professor Prof. Khaled Tarawneh, for suggesting the research, his continuous interest, generous guidance, constructive criticism, never ceasing opportunities for insightful discussion and invaluable supervision throughout the course of the work. Also to Prof. Jumah Shakhanbeh and Dr. Wael ALZereine all my thanks and appreciations.

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Eman Ali Mowafi

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List of Abbreviations

AACE	American Associations of Clinical Endocrinologists
AAO	American Academy of Ophthalmology
ADA	American Diabetic Association
ATP III	Adult Treatment Panel III
DM	Diabetes Mellitus
GDM	Gestational diabetes mellitus
HCDP	Heart And Capillary Disease Prevention Directorate
HDL	High density lipoprotein
IDF	International Diabetes Federation
IFG	Impaired Fasting Glycaemia
LDL	Low density lipoprotein
MS	Metabolic Syndrome
NCDs	Non-Communicable Diseases
NCEP	national cholesterol education program
OGTT	Oral glucose tolerance test
ROC	Receiver Operator Characteristic
WHO	World health organization

Abstract

Epidemiological Patterns of Metabolic Syndrome among Type 2 Diabetes in Alkarak Population, South Jordan

Eman Ali Mowafi

Mu’tah University, 2012

The metabolic syndrome prevalence among diabetics was dramatically increasing with the adoption of sedentary lifestyles among Jordanians. This study was conducted to estimate the prevalence of the diabetes mellitus (DM) among Alkarak population, metabolic syndrome (MS) among type 2 diabetes mellitus using Adult Treatment Panel III (ATP III) criteria among southern Jordanians, and impaired fasting glycaemia (IFG) and their epidemiological patterns and associated risk factors.

Data were obtained and analyzed from a cross-sectional hospital-based study (N= 3078) Alkarak population aged ≥ 25 years old, and the total number of diabetics was 650. The identification of metabolic syndrome was based on ATP III criteria.

The prevalence of the MS was 34.2% (males = 17% and females = 45.2%). The MS prevalence was associated with in males and females. The prevalence of the MS was significantly higher in females (Chi-square = 10.09 and p-value = 0.001). BMI, weight, waist circumference, and blood sugar level were significantly decreased after implementation of the nutritional educational program, with t-test and p-value (9.6, $p<0.001$; 11.5, $p<0.001$; 10.6, $p<0.001$; and 11.13, $p<0.001$, respectively).

The metabolic syndrome prevalence in Alkarak is noticeably higher than in other countries. An interventional nutritional and health education programs were highly needed in Alkarak population.

الملخص

الأنماط الوبائية لمتلازمة الأيض بين مرض السكري من النوع 2 في سكان الكرك، جنوب الاردن

إيمان علي موافي

جامعة مؤتة،2012

ان انتشار متلازمة الأيض لدى المصابين بالبول السكري من النوع الثـاني في تزايد كبير وذلك مع اعتماد أساليب الحياة المستقرة بين الأردنيين. وقد أجريـت هذه الدراسة لتقدير معدل انتشار مرض السكري بين السكان في محافظـة الكـرك، وكذلك متلازمة التمثيل الغذائي بين مرضى داء السكري من النوع 2 بين الأردنيين، وكذلك دراسة أنماطها الوبائية وعوامل الخطر المرتبطة بها.

تم الحصول على البيانات وتحليلها عن طريق دراسة مقطعية فـي مستـشفى الكرك الحكومي **(N = 3078)**، بين السكان الذين تتراوح أعمارهم اكثـرمن 25 سنة، وكان العدد الإجمالي لمرضى السكري = 650.

ان معدل انتشارمتلازمة التمثيل الغذائي بين مرضى داء السكري من النـوع 2 كان 34.2٪ (ذكور = 17٪ والإناث 45.2٪ =). كان انتشار متلازمة التمثيـل الغذائي أعلى بكثير فـي الإنـاث وذو دلالـة معنويـة (مربـع كـاي = 10.9، **p<0.001**). ان مؤشر كتلة الجسم انخفض بشكل ملحـوظ وذو دلالـة معنويـة، وكذلك الوزن، ومحيط الخصر، ومستوى السكر في الدم بعد تنفيذ البرنامج التثقيفي الغذائي.

إن انتشار متلازمة الأيض في الكرك هو اعلى بشكل ملحوظ مـن البلـدان الأخرى. هناك حاجة شديدة لتداخلية برامج التعليم والصحة الغذائيـة بـين سـكان الكرك .

CHAPTER ONE
INTRODUCTION

1.1 Theoretical Backgrounds

The awareness pertaining to Diabetes Mellitus has been growing recently. It is not only one of the most well known chronic diseases with tremendous complication profile but also it is one of the major risk factors for other chronic diseases. According to International Diabetes Federation (IDF Diabetes Atlas,2011) the prevalence of diabetes is dramatically increasing. It is the estimated that the number of adults living with diabetes has soared to 366 million, representing 8.3% of the global adult population. This number is projected to increase to 552 million people by 2030, or 9.9% of adults, which equates to approximately three more people being diagnosed with diabetes every 10 seconds. On the other hand, 3.4 million people had died from consequences of high blood sugar (IDF Diabetes Atlas, 2011).

Unfortunately more than 80% of diabetes deaths occur in low- and middle-income countries, with most sufferers aged 40 to 59 years, and 183 million people (50%) with diabetes still undiagnosed. As diabetes caused 4.6 million deaths in 2011, WHO projects this number to double between 2005 and 2030. Consequently, it is not surprising that World Health Organization (WHO) considers diabetes the most critical and global health problem of the 21st century. Providing that Diabetes mellitus (DM) is one of the most common non-communicable diseases (NCDs) globally. Globally, NCDs—principally cardiovascular diseases, diabetes, cancer and chronic respiratory diseases—account for 63% of total number of deaths. In 2008, of the 57 million deaths, 36 million were due to NCDs (Alwan, 2010). Diabetes is the fourth or fifth leading cause of death in most high-income countries and there is substantial evidence that it is reaching epidemic proportions in many economically developing and newly industrialized countries.

In Jordan, Diabetes prevalence is one of the highest in the world, affecting 16% of Jordanian citizens over the age of 18. Moreover, the potential for developing diabetes in Jordan is 30.5% among both children and adults (Ajlouni et al., 1998). Thus, the prevalence of diabetes in Jordan constitutes not only the highest in the region, but also one of the highest in the world. These estimates have been confirmed by the 2007 Jordanian Heart and Capillary Disease Prevention directorate (HCDP) of the Ministry of Health study findings, which showed that 23.8% of Jordanians over 18 years old are likely to become diabetics. Here, it is important to note that Diabetes is considered the fifth main cause of death in Jordan (Meyassar, 2007).

Diabetes contributed to at least USD 465 billion dollars in healthcare expenditures in 2011, accounting for 11% of total healthcare expenditures in adults (20-79 years). By 2030, this number is projected to exceed USD 595 billion (IDF,2011). In 2011, an estimated average of USD 1,274 per person diagnosed with diabetes was spent globally on treating and managing the disease. Hence, it is obvious that diabetes has a significant economic impact on individuals, families, health systems and economies in most countries. For example, WHO estimates that in the period 2006-2015, China will lose $558 billion in foregone national income due to heart disease, stroke and diabetes alone (WHO fact ,2012).

According to the Jordanian National Centre for Diabetes(NCD), in Jordan, the annual direct costs of diabetes treatment—including medication—approach JD654 million, and are matched by the indirect, mainly social, costs. The economic burden of diabetes is becoming even greater due to the late discovery of diabetic patients, which, in turn, leads to more complex treatments and often further complications. It is estimated that 40% of Jordan nationals suffering from diabetes have not been diagnosed (NCD ,2008).

In almost all high-income countries, diabetes is a leading cause of cardiovascular disease, blindness, kidney failure, and lower limb amputation (Amanya , 2008).

It is already well established that there are two major types of Diabetes Milletus—Type 1 and Type 2. Other types, such as gestational diabetes mellitus, are also noted in the medical field. On the other hand, there are some closely related syndromes that accompany diabetes, such as impaired fasting glycaemia (IFG) and metabolic syndrome (MS).

Despite the fact that diabetes is a chronic disease with a complex and extensive complication profile, 80% of Type 2 form is preventable international diabtes fedration (IDF ,2011). Simple lifestyle measures have been shown to be very effective in preventing or delaying the onset of Type 2 diabetes. The main concern is to achieve and maintain healthy body weight, either by being physically active or by eating healthy diet, ideally both. Being physically active is simple and it may be achieved by implementing at least 30 minutes of regular, moderate-intensity activity on most days. However, more activity is also required for weight control, which is best managed by eating healthy diet, i.e. eating between three and five servings of fruit and vegetables a day and reducing sugar and saturated fat intake. In general, it is typically recommended avoiding tobacco use, as smoking is a recognized factor that increases the risk of respiratory and cardiovascular diseases in addition to diabetes (WHO fact,2012) Currently, diabetes is seen as a contemporary human disease in all countries of the world, fast becoming the most prevalent chronic disease among all age groups.

1.2 Diabetes Disease in Jordan

Chronic diseases, such as diabetes, burden Jordan's health care system, due to expensive, long-term treatments and also carry significant social costs.

The growth in diabetes prevalence, previously thought of as a "rich country disease", has been particularly alarming. From 2002 to 2004, the reported rate of diagnosed diabetes increased from 6.3% to 7.4% (Centres for Disease Control and Prevention, 2004). Current estimates range from 16% to 30%, depending on the age range and defined glucose levels (Ajlouni et al.2004). The prevalence of diabetes in Jordan is not only the highest in the world (Ajlouni et al.2004), but—given that a Finnish study estimated that Type 2 diabetes, most commonly known as adult onset, can be prevented in 58% of cases (Tuomilehto et al.2001) this startling statistic clearly indicates the need for action.

The population explosion and resulting demographic transition currently underway in Jordan contribute to the sense of urgency surrounding diabetes. High natural population growth rates mean that a large portion of the population is young, signaling a future crisis should the cultural issues identified above not be addressed. According to the Jordan Health Communication Partnership (JHCP) statistics, 37% of Jordan's 5.7 million residents is comprised of those younger than 15 (JHCP, 2011). Confounding factor in this growing concern is the presence of over 2 million Palestinian and Iraqi refugees.

Several non-governmental and international organizations operating in the country have noted that both groups bring with them high prevalence rates of diabetes alongside other chronic diseases (Amanya Michael, 2008).

Diabetes inflicts heavy economic costs for countries with high rates of the disease (IDF, 2008). Late discovery also contributes to the significant burden, often requiring more expensive and involved treatments. The annual direct costs of diabetes treatment, including medication, approach JD654 million, and are matched by the indirect, mainly social costs. Diabetes also inflicts psychological costs to patients, their families and carers.

Several studies have been conducted in Jordan to determine the prevalence of diabetes and other NCDs. Most of these studies were community based and consistently reported high prevalence of DM between 13 and 17%. Prevalence of pre diabetes (FBS 100 125 mg/100 ml) ranged between 15 and 20% of the surveyed population. The findings of two rounds of Stepwise surveys conducted at the national level in 2004 and 2007 confirmed the high prevalence of diabetes and pre diabetes in Jordan.

1.3 The relationship between diabetes and human diet

Many people think that having diabetes requires a special diet. The diabetes diet, however, is a healthy, enjoyable one, and suitable for the entire family. Nonetheless, learning what a diabetic can eat and how different foods affect the body is important. food is not the only factor that raises glucose(Although, some medication, infections and stress also do)the food choices have a significant impact on the glucose, cholesterol, and blood pressure levels and, of course, the overall health. A diabetic meal plan matches calories from fat, carbohydrate, and protein with the patient's body activity and insulin levels. It is based on grouping foods into what is called the exchange system that translates the prescribed calories into actual foods and their quantities. There are six different exchange lists or groups of food: milk, vegetable, fruit, bread and starch, meat, and fat. Each group contains foods that are similar in protein, fat, and carbohydrate content. The basic principles of good nutrition for the diabetic patient depend on the largest group of the macronutrients.

Carbohydrate, sugars, starches and fibers are the most common and abundant in our diet. These foods are our main source of energy. Because it turns into glucose, digestible carbohydrate provides 3.75 kcal of energy per gram. Different types of carbohydrate foods are digested at different rates and therefore have different effects in terms of raising the blood glucose level after a meal (this is called glycaemic index-GI). Foods with a low GI cause less of a spike in post-meal blood glucose than those with a high GI.

Too much carbohydrate in the diet can raise blood glucose levels to excessively high levels, marking the onset of progression of diabetic complications. Excess carbohydrates in a meal and the resulting uncontrolled blood sugar levels can be detrimental to any number of tissues, from the lens of the eye, to the neurons, small blood vessels and the kidneys. Thus, it is important to limit the total carbohydrate intake at each meal to 45–60 per cent of daily food consumption.

Energy intake should be monitored so that carbohydrate and monounsaturated fat combined account for 60–70% and sucrose no more than 10%. Sucrose does not increase glycemia more than isocaloric amounts of starch. The most important recommendation for patients is to spread carbohydrate intake evenly throughout the day, as this helps prevent high and low blood glucose. The patient must also eat three meals a day, with supplementary snacks, as needed, at regular intervals in order to control hunger and prevent overeating at the next meal.

On the other hand, the diabetic patient must time the food intake to the action of diabetes medication (insulin or tablet time and dose) because the non-insulin dependent diabetic does not need the same consistency in daily routine but must strive to achieve and maintain a reasonable weight.

In addition, fiber can help in feeling fuller for long time, it is useful for those trying to lose weight.

There is no specific amount of fiber recommended for individuals suffering from diabetes. A balanced diet, including plenty of fruit and vegetables, beans and pulses and a variety of grains and cereal products, contain adequate amounts of fiber. As fiber has beneficial effects on glycaemic and lipid control (Giacco, 2000), high-fiber foods may be useful in the management of diabetes mellitus.

The American Associations of Clinical Endocrinologists (AACE) indicates that not much evidence exists to indicate that the patients with diabetes need to reduce their intake of dietary proteins. The AACE recommends that 10-20% of the calorie intake in diabetes should come from proteins (AACE Diabetes Guidelines,2002). It is, in fact, believed that this is one nutrient that does not increase blood glucose levels in diabetics or healthy subjects (Gannon et al.2003).

Including moderate amounts of low-fat protein is deemed to reduce the risk of complications and the high protein diet helps to control hunger between meals. The protein will also slow the absorption of carbohydrate. Some studies by have confirmed that blood glucose levels and glycosylated hemoglobin (a marker of long-term diabetic control) reduce after 5 weeks on a diet containing 30% of the total food energy in the form of proteins and low in carbohydrate. It is speculated that a high protein diet has a favorable effect in the management of diabetes due to the ability of proteins and amino acids to stimulate insulin release from the pancreas (Gannon MC, Nuttall J A.,2001).

Finally, a diabetic patient must limit foods rich in fat, especially animal fat because—although fat does not raise blood glucose—it can lead to being overweight and the excess body weight can raise blood glucose. The high-fat diet also increases incidences of the clogging of arteries with atherosclerotic plaque responsible for a wide range of diabetic complications (ajlouni,K et al.,1998).

1.4 Aims of the Study

Given the above, the present study aims:

1. To determine the prevalence of DM in Alkarak governorate
2. To determine the prevalence of impaired fasting glycaemia (IFG).
3. To determine the prevalence of metabolic syndrome (MS)
4. To assess the gender differences in the prevalence of MS
5. To determine the effectiveness of educational intervention in the risk of developing MS among Alkarak population
6. To assess the onset of DM in Alkarak population

7. To investigate the relationship between basal metabolic index (BMI) and DM
8. To evaluate the effect of exercise therapy on MS

CHAPTER TWO
REVIEW OF LITERATURE

2.1 DM Definition

The most common endocrine disorder and the most prevalent global health problem is diabetes mellitus. Diabetes mellitus is not a single disease, but a diverse group of disorders (WHO, ADA, 2006) characterized by high blood glucose levels that result from defects in the body's ability to produce and/or use insulin. Nonetheless, all forms of diabetes mellitus have one common characteristic—hyperglycemia (Rhoades, 2003). Chronic hyperglycemia causes serious health complications, including damage, dysfunction, and failure of different organs—mainly eyes kidneys, nerves, heart, and blood vessels (WHO, 2002) (ADA, 2006)

2.2 DM History

Diabetes is an ancient disease (Sue Rodwell, 2002) . with an Egyptian manuscript from c. 1500 B.C mentioning "too great emptying of the urine”. The first defined cases are believed to be of Type 1. In India, physicians identified the disease as "honey urine", after noticing that the urine would attract ants (Leonid, 2009). Moreover, in 230 BCE, Apollonius of Memphis coined the name "diabetes” meaning "to go through" or siphon, as he understood that the disease drained more fluid than a person could consume (Harris and Zimmet, 1997).

The sweet taste of urine was noted by the ancient Greeks, Chinese, Egyptians, Indians, and Persians. However, as no treatment was available at the time, diabetes mellitus appears to have been equivalent to a death sentence in the ancient era. Hippocrates makes no mention of it, which may indicate that he perceived the disease as incurable. Although Aerates, the famous Greek physician, did attempt to treat it, his prognosis was unfavorable, as he commented that "life (with diabetes) is short, disgusting and painful"(Dallas, 2011).

The earliest surviving work with a detailed reference to diabetes is that of Aerates of Cappadocia (2nd or early 3rd c. AD). In medieval Persia, Avicenna (980–1037) provided a detailed account on diabetes mellitus in "The Canon of Medicine", "illustrating the abnormal appetite and the disability of sexual functions and he recorded the sweet taste of urine." Like Aretaeus before him, Avicenna diagnosed primary and secondary diabetes as well as describing diabetic gangrene. He treated diabetes using a mixture of lupine, trigonella (fenugreek), and zedoary seed, which apparently produced considerable results. In 1776, Matthew Dobson confirmed that urine had sweet taste was because of an excess of sugar in the urine and blood of people with diabetes. Galen named the disease "diarrhoea of the urine" (diarrhoea urinosa) (Laios Konstantinos, 2012).

Type 1 and Type 2 diabetes where identified as separate conditions for the first time by the Indian physicians Sushruta and Charaka in 400-500 AD, with Type 1 associated with youth, and Type 2 with being overweight. The term "mellitus" or "from honey" was added by the Briton John Rolle in the late 1700s, in order to separate the condition from diabetes insipidus, which is also associated with frequent urination (Oxford English Dictionary, 2011). Although Avicenna described diabetes insipidus for the first time, it was Johann Peter Frank (1745–1821) who later differentiated between diabetes mellitus and diabetes insipidus (Leonid Poretsky, 2009).

Joseph von Mering and Oskar Minkowski discover the role for the pancreas in diabetes, as, in 1889 (CDA, 2012), they found that dogs whose pancreas was removed developed all the signs and symptoms of diabetes and died shortly afterwards. In 1910, Sir Edward Albert Sharpey-Schafer suggested that people with diabetes were deficient in a single chemical that was normally produced by the pancreas—proposing the term "insulin" to describe this substance, as it is derived from the Latin "insula", meaning island, in reference to the insulin-producing islets of Langerhans in the pancreas.

Canadians Frederick Banting and Charles Herbert Best start their experiments in July of 1921. They operated on the dogs, tying off the ducts so digestive juices leave the pancreas. Later on, Banting detached the weakened organs and then injected an extract from the islet tissues into dogs whose pancreas he had detached. The principal symptom of diabetes is a high level of sugar in the blood. To Banting's delight, his injections lowered the level of sugar in the blood of several diabetic dogs (Leonid Poretsky, 2009). After this pioneering work was the development of the long-acting insulin NPH in the 1940s.

Despite the availability of treatment, diabetes has persisted as a major cause of death. For instance, statistics reveal that the cause-specific mortality rate during 1927 amounted to about 47.7 per 100,000 inhabitants in Malta.

2.3 DM Epidemiology

The mortality of Diabetes (DM) has risen in many countries in recent decades, due to the rapid change in lifestyle that led to unhealthy diet and lack of physical inactivity. It is important to note that these estimates of burden on national healthcare systems are for Type 2 diabetes only and do not estimate the additional burden of cardiovascular disease (CVD) associated with metabolic syndrome, where clinical diabetes is not yet present.

While the global prevalence of diabetes is 6.4%, it varies from 10.2% in the Western Pacific to 3.8% in the African region. However, the African region is expected to experience the highest increase (IDF, 2010). Nearly

26 million children and adults in the United States have diabetes and further 79 million Americans have pre-diabetes and are at risk for developing Type 2 diabetes.

In 2010, almost 27 million people, or 7.7% of the adult population in the MENA region (The MENA region, as defined by the International Diabetes Federation, includes Middle East and North Africa, Afghanistan, Algeria, Armenia, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Palestine, Qatar, the Kingdom of Saudi Arabia, Sudan, Syria, Tunisia, the United Arab Emirates and Yemen) were living with diabetes, accounting for 9.3% of all the diabetics in the world. If no action is taken now, it is estimated that, by 2030, this number will almost double, to an alarming 51.7 million (IDF, 2009).

Six countries in the MENA region—Bahrain, Egypt, Kuwait, Oman, Saudi Arabia and the United Arab Emirates—are among the world's ten highest for prevalence rates for both diabetes and impaired glucose tolerance, which often leads to diabetes. Other countries, i.e. Egypt (11.4%), Iraq (10.2%), Jordan (10.1%) and Lebanon (7.8%), are less affected by this condition (IDF, 2010).

Generally, diabetes is costly to health care systems, as it requires more outpatient visits, more medication, is associated with a higher probability of a patient being hospitalized and requiring emergency and long-term care than individuals without the disease. In the United States, people with diabetes, on average, spend 2.5 times more on medical care than do those without the condition (Harper, 2001).

The WHO predicted net losses in national income in the period between 2005 and 2015 of ID 557.7 billion in China, ID 303.2 billion in the Russian Federation, ID 336.6 billion in India, ID 49.2 billion in Brazil and ID 2.5 billion in Tanzania , due to diabetes and cardiovascular disease.

The annual direct healthcare cost of diabetes worldwide for this group is estimated at minimum of 286 billion ID. As it is likely that this figure will increase to 396 billion ID by 2025, up to 13% of the world's healthcare budget would be spent on diabetes care, with this number reaching 40% in high prevalence countries (Diabetes Atlas, 2006).

In 2007, the American Diabetes Association estimates that the total national cost of diagnosed diabetes in USA was $174 billion (with $116 billion for direct medical costs, and $58 billion for indirect costs [disability, work loss, premature mortality]) (ADA, 2007).

For Canada, the diabetes-related expenses are currently at approximately $11.6 billion, compared to a 2000 figure of $6.3 billion, with $16.9 billion estimated for 2020 (CDA). In Germany, it is estimated that €43.2 billion ($57 billion) is spent on diabetes as direct annual costs (LSE), with China spending $25 billion annually, as of 2010 (IDF and Chinese Diabetes Society).

2.4 Physiology of DM

A number of studies have examined physiological function in people with non-diabetic fasting plasma glucose levels (< 7.0 mmol/l) and have described a range of abnormalities. For example, Godsland and others (2004) reported that first phase insulin response in non-diabetic individuals begins to decrease from a fasting plasma glucose of 5.0–5.4 mmol/l and late-phase insulin response declines at a fasting plasma glucose above 6.0 mmol/l. Similarly, Piche and others (2004) reported a progressive decline in indices of ß-cell function and insulin sensitivity even within the fasting plasma glucose range considered normal.

Compared with individuals with a fasting plasma glucose levels of <4.9 mmol/l, patients with a fasting plasma glucose between 5.3 and 6.1 mmol/l are found to be more insulin resistant, have higher insulin and C-peptide responses during an OGTT and had reduced insulin secretion. Even those with fasting plasma glucose of 4.9 to 5.3 mmol/l are characterized by impaired insulin secretion and decreased insulin sensitivity compared to individuals with the lowest fasting plasma glucose.

Body cells need energy in order to function. The body's primary energy source is glucose, a simple sugar resulting from the digestion of food. Glucose from the digested food circulates in the blood as a ready energy source for the cells that need it. However, glucose requires insulin to enter cells, in which insulin binds to a receptor site on the outside of the cell and thus acts like a key that opens a doorway through which glucose can enter the cell.

Insulin is a protein hormone that is synthesized in the pancreas, and secreted by the beta cells of the islets of Langerhans (Sue Rodwell, 2002). It is essential for the metabolism of carbohydrates, lipids, and proteins. It regulates blood sugar levels by via mechanisms. Insulin facilitates uptake of glucose into tissues, and enhances its conversion into glycogen, fatty acids and triglycerides. Moreover, it reduces the release of glucose from the liver (Rhoades, 2006).

When there is an insufficient quantity of insulin or when the doorway no longer recognizes the insulin key, glucose stays in the blood rather than entering the cells, resulting in a condition known as “Hyperglycemia”. In this case, the body will attempt to dilute the high level of glucose in the blood by excreting it in the urine or drawing water out of the cells into blood stream.

When the excreted glucose in urine reaches high levels, urination that is more frequent occurs and, consequently, affected individuals feel thirsty and drink large quantities of water, which leads to even more urination that is frequent.

Drawing water out of the cells into blood stream in an attempt to remove glucose from the blood leads to cells being ‘starved’ of glucose,

resulting in signals sent to the body to eat more food in order to provide energy for the starving cells. This process makes patients extremely hungry. On the other hand, the body is also trying to convert fats and proteins to glucose. The breakdown of fats and proteins for energy performs acid compounds called ketones that will also be excreted in the urine. As ketones build up in the blood, a condition called ketoacidosis can occur. This condition can be life threatening if left untreated, leading to coma and death.

2.5 DM Signs

These signs can rapidly worsened and become emergency conditions

1. Numbness, tingling, or pain in feet or legs
2. Problems with eyesight
3. Sores or infections on feet
4. Symptoms of high blood sugar (being very thirsty, having blurry vision, having dry skin, feeling weak or tired, needing to urinate a lot)
5. Symptoms of low blood sugar (feeling weak or tired, trembling, sweating, feeling irritable, having trouble thinking clearly, fast heartbeat, double or blurry vision, feeling uneasy) (Alemzadeh,2011)

2.6 DM Symptoms

1. Polyphagia (Increased Hunger): The cells become starved for glucose and hunger increases (Berthoud HR,2011).
2. Polyuria (frequent Urination) and polydipsia (increased thirst): Increased levels of sugar in the bloodstream cause the kidneys to attempt to filter out sugar and return it to the bloodstream. As the kidneys may not be able to keep up with the increased load, the excess sugar passed into the urine, whereby bodily fluids are drawn from tissues to help excrete the sugar from the body. Urination thus increases, causing dehydration and thirst. This leads to drinking more fluids, which, in turn, increases urination (Colin, 2009).
3. Dry Mouth: This symptom is a consequence of dehydration (ADA,2012).
4. "Fruity" Breath: In this case, the body switches to using fat for energy. Ketones are a by-product of burning fat for energy and acetone, a type of ketone, has a telltale fruity scent that is similar to the scent of nail polish remover (ADA,2012).
5. Blurry Vision: High blood sugar can cause changes to the lenses of the eyes (WHO). The lenses may become distorted and can lose flexibility, making it harder to focus. This can cause damage to the eyes and lead to changes in vision and even blindness. Other changes to the eyes are also possible, which may result in cloudy vision,

double vision, floaters, shadows, cataracts, vision changes, and bleeding (ADA,2012)

6. Fatigue: Dehydration causes fatigue. Moreover, the inability to use sugar properly and efficiently for energy needs can also cause fatigue.
7. Irritability: It may be caused by fluctuating blood sugar levels and the body's struggle to maintain normal levels, as these can affect mood (Lustman PJ'2005).
8. Headaches: Diabetes can affect various bodily systems that can create conditions that cause headaches, such as high blood sugar, eye problems, and high blood pressure (K Kaushal,2003).
9. Itching: It can be due to infection, dryness, or poor blood circulation. Itching in the genital area is common with high blood sugar levels. The lower part of the legs is another common area where itching occurs and can be a sign of early diabetes.
10. Unusual Weight Changes: Individuals affected by Type 2 diabetes typically do not lose as much weight as those with Type 1 diabetes (ADA,2012).
11. Frequent Infection: Frequent infections, such as frequent and persistent yeast infections in women, skin infections, urinary infections, or gum and mouth infections, are diabetes symptoms that may be due to high blood sugar levels, as they can cause damage to the circulatory and nervous systems (ADA,2012).
12. Sores, cuts, and bruises that take a long time to heal: Poor circulation and nerve damage caused by high blood sugar can cause healing difficulty and injury unawareness, especially in the feet. When injuries go untreated and they are slow to heal, they can develop into serious problems that are hard to correct (ADA, 2012).
13. Numbness or Tingling in the Hands or Feet: High levels of sugar can cause damage to the nervous system, which can produce a tingling sensation. However, it can take years for this symptom to appear (ADA, 2012).
14. Sexual Dysfunction: Sexual dysfunction problems related to Type 2 diabetes include decreased sex drive, erectile dysfunction in men, and difficulty, discomfort, or pain during sex for women. These symptoms can be caused by high blood sugar levels that damage the nervous and circulatory systems, which are important for normal sexual function, or may lead to yeast infections and dehydration, both of which can make sex uncomfortable(Keith A,2008)
15. Skin Complications or Changes: There are many skin conditions related to diabetes. People with diabetes get more frequent bacterial and fungal infections. They also have more problems with itching. One of the more common skin conditions related to diabetes is a

condition called *acanthosis nigricans*, which causes velvety dark skin in the folds and creases in the skin, such as the neck, groin, and armpits. Other skin changes, such as spots, scaly patches, blisters, bumps, rashes, and thinning or thickening of the skin, are also common (ADA,2012).

2.7 Complications

The occurrence of diabetes-specific complications has been used to derive diagnostic cut-points for diabetes, particularly using data from epidemiological studies that have examined both prevalent and incident retinopathy across a range of plasma glucose levels. However, the adopted approaches have differed in terms of the methods used to diagnose retinopathy and whether or not patients with previously diagnosed diabetes were included in the analysis. If those with diagnosed diabetes who are receiving blood glucose lowering treatment are included, although the population-based characteristics of the study sample are maintained, a bias associated with treatment-induced effects on plasma glucose is introduced.

Diabetes is typically a chronic disease, associated with a shorter life expectancy (estimated at about 10 years) (Williams,2012) . This is partly due to a number of complications with which it is associated including: two to four times higher risk of cardiovascular disease, including ischemic heart disease and stroke, a 20-fold increase in lower limb amputations, and increased rates of hospitalizations.

In the developed world, and increasingly elsewhere, Type 2 diabetes is the largest cause of non-traumatic blindness and kidney failure (Rhoades,2003). It has also been associated with an increased risk of cognitive dysfunction and dementia through disease processes such as Alzheimer's disease and vascular dementia (ADA, 2005). Other diabetes-related complications include *acanthosis nigricans*, sexual dysfunction, and frequent infections (Laios, 2012).

Long-term complications of diabetes develop gradually; consequently, having diabetes for a longer period of time and not having the blood sugar well controlled increases the risk of complications. Eventually, diabetes complications may be disabling or even life-threatening. Possible complications as (ADA,2012) include:

1. Cardiovascular disease: Diabetes dramatically increases the risk of various cardiovascular problems, including coronary artery disease with chest pain (angina), heart attack, stroke and narrowing of the arteries (atherosclerosis) in which an artery wall thickens as a result of the accumulation of fatty materials such as cholesterol (Maton,1993).
2. Nerve Damage (Neuropathy): Excess sugar can injure the walls of the tiny blood vessels (capillaries) that nourish nerves, especially in

the legs. This can cause tingling, numbness, burning or pain that usually begins at the tips of the toes or fingers and gradually spreads upward. Left untreated, diabetic people could lose all sense of feeling in the affected limbs. Damage to the nerves related to digestion can cause problems with nausea, vomiting, diarrhoea, or constipation. In men, it may lead to erectile dysfunction.

3. Kidney Damage (Nephropathy): The kidneys contain millions of tiny blood vessel clusters (glomeruli) that filter waste from blood. Diabetes can damage this delicate filtering system. Severe damage can lead to kidney failure or irreversible end-stage kidney disease, requiring dialysis or a kidney transplant.
4. Eye Damage (Retinopathy): Diabetes can damage the blood vessels of the retina (diabetic retinopathy), potentially leading to blindness. This occurs when blood vessels in the retina change, whereby they sometimes swell and leak fluid, or even close off completely. There are two types of diabetic retinopathy. Background or non-proliferative diabetic retinopathy (NPDR) it is the earliest stage of diabetic retinopathy. With this condition, damaged blood vessels in the retina begin to leak extra fluid and small amounts of blood into the eye. In contrast, proliferative diabetic retinopathy (PDR) mainly occurs when many of the blood vessels in the retina close, preventing enough blood flow (American Acadmy of Opthalmology, 2012)
5. Foot Damage: Nerve damage in the feet or poor blood flow to the feet increases the risk of various foot complications. Left untreated, cuts and blisters can become serious infections. Severe damage might require toe, foot or even leg amputation.
6. Skin and Mouth Conditions: Diabetes may leave an affected individual more susceptible to skin problems, including bacterial and fungal infections. Gum infections also may be a concern, especially when accompanied by a history of poor dental hygiene.
7. Brain Problems: Recent research suggests that high blood sugar levels may increase the risk of Alzheimer's disease in patients suffering from Type 2 diabetes, even though a certain gene is now linked to the development of Alzheimer's disease. Further research is needed to confirm this link.
8. Cancer: People with diabetes have a higher risk of some cancers for the reasons that remain unclear. It is possible that the factors that increase the risk of Type 2 diabetes also increase the risk of cancer, or it may be a factor of the disease or its treatment. Although this is an active area of research, but in the meantime, as no definitive findings are published, no changes in treatment are recommended.

2.8 DM Diagnosis

The current diagnostic criteria for detecting diabetes and intermediate hyperglycemia have been in place globally for almost a decade and are widely accepted. However, in 2003, the ADA modified its recommendations, moving them away from those of the WHO. Although attention has focused on the difference in fasting plasma glucose levels for defining IFG, there are a number of important differences between the ADA and WHO recommendations that may result in differences in an individual's classification of glucose tolerance.

The key discrepancies include: fasting plasma glucose value used to define IFG inclusion of 2–h plasma glucose value in defining IFG requirement for fasting plasma glucose level in defining IGT fasting plasma glucose as the recommended method for diagnosing asymptomatic diabetes by ADA whereas WHO recommends the oral glucose tolerance test. These discrepancies have implications for the individual and for population prevalence estimates. For example, individuals in the ADA category of IFG could include those with IGT or diabetes, if 2–h plasma glucose is not measured, and ADA-defined IGT could include diabetes, if fasting plasma glucose is not measured. The objective of the Technical Guideline Development Group meeting was to examine the evidence on the following issues related to the diagnosis of diabetes and intermediate hyperglycemia:

1. Should the current diagnostic criteria for diabetes be changed ?
2. How should normal glucose levels be defined?
3. How should impaired glucose tolerance be defined?
4. How should impaired fasting glucose be defined?
5. What diagnostic tests should be used to define glucose tolerance status?.

On the other hand, diabetes is typically suspected based on symptoms and in such cases urine and blood tests can be used to confirm the diagnosis of diabetes based on the amount of glucose found via group of tests such as:

1. Urine Tests: Clinistix and Diastix are paper strips or dipsticks that change color when dipped in urine. The test strip is compared to a chart that shows the amount of glucose in the urine based on the change in color. However, as the level of glucose in the urine lags behind the level of glucose in the blood, testing the urine with a test stick, paper strip, or tablet that changes color when sugar is present is not as accurate as blood testing. Nonetheless, it can give a fast and simple reading. Ketones in the urine can be detected using similar types of dipstick tests (Acetest or Ketostix). Ketoacidosis can be a life-threatening consequence of Type I diabetes; thus, having a quick and simple test to detect ketones can assist in establishing a diagnosis sooner. Another

dipstick test can determine the presence of protein or albumin in the urine, whereby protein in the urine can indicate problems with kidney function and can be used to track the development of renal failure. A more sensitive test for urine protein uses radioactively tagged chemicals to detect microalbuminuria, as small amounts of protein in the urine that may not show up on dipstick tests (Gale Encyclopediaof Diets ,2008)

2. Fasting Glucose Test: Blood is drawn from a vein in the patient's arm after a period at least eight hours of fasting, usually in the morning, before breakfast. The red blood cells are separated from the sample and the amount of glucose is measured in the remaining plasma. A plasma level of 11.1 mmol/l (200 mg/dl) or greater can indicate diabetes.
3. Postprandial Glucose Test: Blood is taken right after the patient has eaten a meal. Levels of 7 mmol/L (126 mg/dl) or greater can indicate diabetes.

Oral Glucose Tolerance Test: There is continuing debate about the place of the OGTT for clinical and epidemiological purposes, even though the test is recommended by the (World Health Organization, 1999) and ADA acknowledges the OGTT as a valid way to diagnose diabetes. Nonetheless, the use of the test for diagnostic purposes in clinical practice is discouraged in favor of fasting plasma glucose for several reasons, including inconvenience, greater cost and less reproducibility (The Expert Committee, 1997). Some of this variation can be minimized withattention to dietary preparation and taking care to collect the 2–h sample within 5 min of 120 min (Kanedo et al., 1998).

Many studies have reported that fasting plasma glucose and 2–h post-glucose plasma glucose do not lead to the same diabetes diagnosis. In the DECODE study (DECODE Study Group), of the 1517 people with newly diagnosed diabetes, 40% met only the fasting plasma glucose criterion, 31% met only the 2–h plasma glucose criterion and 28% met both criteria. Therefore using only the fasting plasma glucose will fail to diagnose approximately 30% of individuals suffering from diabetes. Data from the NHANES III study cited in the (ADA, 1997) report show similar findings for newly diagnosed diabetes. This discrepancy is more obvious in an older population.

(Barrett and Ferrara, 1998) reported that 70% of women and 48% of men aged 50–89 years were newly diagnosed with diabetes solely based on the elevated 2–h plasma glucose levels. This raises the question of whether there are any differences in outcomes for people diagnosed based on the fasting or 2–h plasma glucose or both. Many studies have documented increased rates of mortality in people with diabetes. Authors that compared these rates in relation to diabetes diagnosed on the basis of fasting or 2–h plasma glucose have consistently reported worse outcomes in those diagnosed on the basis of the 2–h plasma glucose result. The Hoorn study

showed that all-cause and cardiovascular mortality over an 8–yr follow-up was significantly elevated in those with 2–h plasma glucose ≥ 11.1 mmol/l, but not in those with a fasting plasma glucose ≥ 7.0 mmol/l (F de Vegt and Dekker, 1999). In the DECODE study, hazard ratios (HR) (95% CI) for diabetes diagnosed on a fasting plasma glucose ≥ 7.0 mmol/l was 1.6 (1.4 – 1.8) for all-cause mortality, 1.6 (1.3 – 1.9) for cardiovascular mortality, and 1.6 (1.4 – 1.9) for non-cardiovascular mortality. The corresponding HRs for diabetes diagnosed on a 2–h plasma glucose ≥ 11.1 mmol/l were 2.0 (1.7 – 2.3), 1.9 (1.5 – 2.4) and 2.1 (1.7 – 2.5), respectively. The HR for previously undetected diabetes defined by the 2–h plasma glucose was not significantly different from that for known diabetes, but was significantly higher than that for undetected diabetes based on the fasting plasma glucose (DECODE Study Group, 2003).

A further DECODE analysis has shown that, while mortality is increased in patients newly diagnosed with diabetes—based on either the fasting plasma glucose or 2–h plasma glucose—this increased risk is no longer significant for fasting plasma glucose ≥ 7.0 mmol/l when adjusted for 2–h plasma glucose. Nonetheless, the risk based on 2–h plasma glucose ≥ 11.1 mmol/l remains significant when adjusted for fasting plasma glucose (DECODE study group, 2001).

Jonathan E. Shaw and others (1999) reported a 2.7-fold increased risk of all-cause mortality in men and a 2-fold increase in women from three population-based longitudinal studies (in Mauritius, Fiji and Nauru) in individuals with newly diagnosed diabetes on the basis of an elevated 2–h plasma glucose compared to those with normal glucose tolerance. In contrast, patients with diabetes diagnosed on the basis of fasting plasma glucose alone did not have an increased risk.However, not all studies have observed this finding. The 2–h plasma glucose also seems important for micro-vascular complications. Ito and others reported that the incidence of retinopathy in people with newly diagnosed diabetes increased substantially only in those with 2–h plasma glucose levels above 11.1 mmol/l, and even in those with fasting plasma glucose ≥ 7.0 mmol/l. However, none of the patients with fasting plasma glucose ≥ 7.8 mmol/l, but 2–h plasma glucose < 11.1 mmol/l developed retinopathy.

In sum, there is some evidence that diabetes diagnosed solely on the basis of elevated 2–h plasma glucose is associated with a worse prognosis than diabetes diagnosed on the basis of elevated fasting plasma glucose alone for both mortality and retinopathy. Therefore, diagnosing the 30% of individuals who have diabetes only on the basis of elevated 2–h plasma glucose may have prognostic implications, as this group can only be identified using OGTT. In addition, IGT can only be diagnosed with an OGTT.

2.9 DM Treatment

A. **Managing Blood Sugar:** Self-testing means checking blood sugar levels at home and writing down the results that indicate how well diabetes is managed. A device called a glucometer can give an exact blood sugar reading that can be used to change meals, activity, or medications to keep blood sugar levels in the right range (Eisenbarth, 2008).

B. **Diet and Weight Control:** Working closely with a doctor, nurse, and dietician, patients can learn how much fat, protein, and carbohydrates they need to consume on a daily basis. The meal plans should fit daily lifestyle and habits. Managing weight and eating a well-balanced diet are important.

C. **Regular Physical Activity:** Regular exercise is important for all, in particular for diabetics. Exercise that causes the heart to beat faster and speeds up the breathing helps lower blood sugar levels without medication. It also burns extra calories and fat, so patients can manage their weight more easily.

1 Exercise helps improve patient's health by improving blood flow and pressure, reducing risks of cardiovascular diseases, and helping control weight. Exercise also increases the body's energy levels, lowers tension, and improves ability to handle stress (Pignone, 2010).

2 Decreased insulin resistance and increased insulin sensitivity increase peripheral use of glucose not only during but also after the activity. Improved insulin sensitivity occurs without change in body weight. Exercise also decreased the effects of counter-regulatory hormones responsible for reducing the hepatic glucose output and improved glucose control.

3 Finally, exercising for 30 to 60 minutes per a day can result in 10% to 20% reduction in triglyceride levels (ADA, 2002). Before starting any exercise program, however, patients with Type 2 diabetes must consult their doctor. Moreover, they should take precautions before, during, and after intense physical activity or exercise depending on interest, age, general health, and level of physical fitness

D. **Medications used for DM Treatment**

If diet and exercise do not help keeping blood sugar at normal or near-normal levels, doctor may recommend using medications that help lower blood sugar levels in different ways.

Some of the most common types of medication are listed below. They are taken by mouth or injection.

1. Alpha-glucosidase inhibitors (such as acarbose)
2. Biguanides (Metformin)
3. Injectable medicines (including exenatide, mitiglinide, pramlintide, sitagliptin, and saxagliptin)

4. Meglitinides (including repaglinide and nateglinide)
5. Sulfonylureas (like glimepiride, glyburide, and tolazamide)
6. Thiazolidinediones (such as rosiglitazone and pioglitazone). (Rosiglitazone may increase the risk of heart problems)

These drugs may be given in combination with insulin, which may be used alone. Patient may need insulin if they remain having poor blood glucose control. Insulin must be injected under the skin using a syringe or insulin pen device. Pregnant women diagnosed with Type 2 diabetes may be advised to use insulin during their pregnancy and while breast-feeding (Pignone,2010).

2.10 Preventing Complications

The doctors recommend medications or other treatments to reduce the chances of developing eye disease, kidney disease, and other conditions that are more common in people with diabetes (Buchwald,2009).

Foot Care

Individuals with diabetes are more likely to have foot problems, as the disease can damage nerves, causing the patients not to feel an injury to the foot until a large sore or infection develops. Diabetes can also damage blood vessels.

Diabetes also decreases the body's ability to fight infection. Small infections can quickly get worse and cause the death of skin and other tissues (Buchwald,2009).

2.11 DM Effect on Pregnant Women and Their Babies

Gestational diabetes is described as any degree of glucose intolerance in onset or first detection during pregnancy. It occurs in about 18% of pregnancies (ADA, 2012) and affects the mother in late pregnancy, during second or third trimester. However, untreated or poorly controlled gestational diabetes can also harm the baby.

In gestational diabetes, although the pancreas works hard to produce insulin, it fails to lower the blood glucose levels. Moreover, insulin does not inter placenta, but glucose and other nutrients do. Thus, more blood glucose is transmitted to the baby via the placenta, leading to high blood glucose levels in the fetus. This increases maternal plasma glucose levels as well as insulin, stimulating fetal growth.

Another potential outcome is fetal *macrosomia*, whereby a newborn is significantly heavier than 4 kilograms. About 9% of babies born worldwide are in this category (MFMER).

Babies suffering from *macrosomia* face health problems, including shoulder dystocia in which the anterior shoulder of the infant cannot pass below the pubic *symphysis* during birth (RCOG. 2005). Because of the extra insulin made by the baby's pancreas, newborns may have very low

blood glucose levels at birth and are also at higher risk for breathing problems. Babies with excess insulin become children who are at risk for obesity and are at risk for Type 2 diabetes mellitus in adulthood (ADA, 2012).

Macrosomia can lead to trauma during birth and a greater chance of a cesarean delivery. Depending upon the relative size of the head of the baby and the pelvic diameter of the mother, vaginal birth may become complicated (Neil K. Kaneshiro,2011)

2.12 DM Types

As noted earlier, Diabetes Miletus can be of Type 1 or Type 2.

1. **Type 1 diabetes** (previously known as insulin-dependent, juvenile or childhood-onset) is characterized by deficient insulin production and requires daily administration of insulin. Only 5% to 10% of people with diabetes have this form of the disease. The cause of Type 1 diabetes is not known and it is presently not preventable.
2. **Type 2 diabetes** (formerly called non-insulin-dependent or adult-onset) is the most common type of diabetes results from the body's ineffective use of insulin. It is suffered by 90% of diabetic patients around the world, and is largely the result of excess body weight and physical inactivity. Although it usually occurs in adults, it is increasingly seen in children and adolescents (WHO Fact sheet 2011).

While Type 1 DM results from lack of insulin affected by destruction of beta cells, Type 2 patients do produce insulin, but their tissues are insulin resistant. Consequently, the pancreas in-creases production and finally loses its capability to produce insulin. Consequently, two metabolic defects are noted in people with T2DM—insulin resistance and relative insulin deficiency. However, insulin resistance can last for many years before the onset of diabetes (Kaplan and Conway 2004).

T2DM is mostly characterized by peripheral insulin resistance with shortage of insulin. Insulin resistance begins with a cell-receptor defect, resulting in the body's inability to use insulin. Consequently, glucose cannot be absorbed into cells to provide energy and decrease insulin mean excess production of glucose from the liver (Mulcahy and Lumber, 2004).

While Type 1 is more common among Caucasians compared to individuals of other races, Type 2 diabetes is more common in African Americans, Latinos, Native Americans, Asian Americans, Native Hawaiians and other Pacific Islanders, as well as the aged population (NDIC 2005) Exogenous insulin is mandatory for the treatment of Type 1, while Type 2 diabetes can be managed without insulin. However, using insulin for Type 2 diabetes is still an option when other alternatives failed to manage the disease.

Type 2 is clearly differentiated from Type 1 in terms of associated risk factors, such as obesity, poor diet, physical inactivity and sedentary life, increasing age, family history of diabetes, ethnicity, and poor nutrition during pregnancy affecting the developing child.

3. **Gestational diabetes (GDM)** is hyperglycemia with onset or first recognition during pregnancy (WHO media center) occurs when blood sugar levels are higher than pre-pregnancy levels, insulin-antagonist hormone levels increase, and insulin resistance normally occurs. The exact causes are not presently known, but some experts suggest that the hormones produced by the placenta may interfere with the mother's ability to use the insulin her body produces.

As gestational diabetes normally develops later in pregnancy, the baby is already well formed but still growing. The risk to the baby is therefore lower than to those whose mothers have Type 1 or Type 2 diabetes. However, women with GDM still have to control blood glucose levels to minimize the risks to the baby. This can normally be done through a healthy diet but insulin or oral medication may also be needed. (WHO fact sheet).

This type of diabetes needs to be controlled so the baby is not affected, but since most women are screened during pregnancy, gestational diabetes is usually detected early, thus minimizing the effect on the fetus. Gestational diabetes usually does not persist after delivery. Nonetheless, once a woman had gestational diabetes, there is a 2 in 3 chance that she will have the same issue in future pregnancies (NDIC, 2005).

2.13 Impaired Glucose Metabolism or Pre-diabetes and Insulin Resistance

In some individuals, blood glucose readings are not high enough to be classified as diabetes, but they are not within normal range either. This condition used to be referred to as borderline diabetes, but is more commonly known as an impaired glucose metabolism or pre-diabetes. There are two pre-diabetes conditions—impaired glucose tolerance (IGT) and impaired fasting glucose (IFG).

Impaired glucose tolerance (IGT) refers to the condition whereby blood glucose levels are higher than normal but not high enough to be classified as diabetes. In such cases, blood glucose levels are escalated in the fasting state.

These conditions are more common in individuals that have a family history of Type 2 diabetes, are inactive and overweight, particularly when excess weight is carried around the waistline. Impaired glucose metabolism does not lead to Type 2 diabetes in the future; still, such patients have a 10-20 times greater risk than those with normal blood glucose levels. Being diagnosed with an impaired glucose metabolism should thus be taken as a

warning sign and an opportunity to make positive lifestyle changes to prevent Type 2 diabetes in the future.

Secondary diabetes is a condition in which some common medications can damage the body's use of insulin. These medications include treatments for high blood pressure (furosemide, clonidine, and thiazide diuretics), drugs with hormonal activity (oral contraceptives, thyroid hormone, *progestins*, and *glucocorticorids*), and the anti-inflammation drugs, such as indomethacin. In addition, some drugs that are used in mood disorders (such as anxiety and depression) can also impair glucose absorption. These drugs include haloperidol, lithium carbonate, phenothiazines, tricyclic antidepressants, and adrenergic agonists. Other medications that can cause diabetes symptoms include isoniazid, nicotinic acid, cimetidine, and heparin. A study conducted in 2004 found that low levels of the essential mineral chromium in the body might be linked to increased risk for diseases associated with insulin resistance

2.14 Metabolic Syndrome

The metabolic syndrome (also known as metabolic syndrome X or the dysmetabolic syndrome) is a group of metabolic abnormalities that includes hyperlipidaemia [elevated triglycerides (TG), low serum high-density lipoprotein (HDL) cholesterol], hypertension, central obesity and elevated blood glucose (American Heart Association) The syndrome is known to be associated with greater risk of coronary heart disease, stroke and cardiovascular mortality compared to the risk conferred by each one of its individual components (Sattar,Golden,2003). This condition was first noted by Kylin in 1920 (Kylin), and its prevalence in the U.S.A. varies with the measurement criteria. Thus, based on the national cholesterol education program (NCEP) definition, it is currently approximately 35%. Using newer definition from the international diabetes federation (IDF), almost 40% of the US population would be classified as having the metabolic syndrome .

The risk factors for metabolic syndrome are many, with insulin resistance and central obesity (especially abdominal obesity) as most significant (Tuomilehto et al).

According to The American Heart Association, metabolic syndrome is diagnosed if any three or more of the following abnormalities are present in the patient: v; Elevated waist circumference— 40 inches (102 cm) or more for men and 35 inches (88 cm) or more for women; Elevated triglycerides—150 mg/dL; Reduced HDL (“good”) cholesterol—less than 40 mg/dL in men and less than 50 mg/dL in women; Elevated blood pressure—130/85 mm Hg or higher; and Elevated fasting glucose—100 mg/dL or higher.

2.15 Risk Factors for Pre-diabetes and Type 2 Diabetes

The validity of the current definition of diabetes centers on the measurement of the risk of developing diabetes or risk of adverse outcomes associated with 2–h plasma glucose levels. The 2–h post-load plasma glucose cut-point of 7.8 mmol/l for defining IGT was derived primarily from Pima Indian data collected as a part of the study that examined the risk of incident diabetes (Bennett et al., 1998). The incidence ranged from less than 2.0 percent/yr in those with 2–h plasma glucose levels of < 5.6 mmol/l to 6.8 percent/yr in those with 2–h values of 7.8–11.0 mmol/l. A subsequent analysis of six prospective studies showed incidence rates of diabetes in people with IGT that ranged from 35.8 to 87.3/1000 person-yrs (Edelstein et al., 1997). The rates increased with higher fasting plasma glucose and body mass index. Unlike data associated with IFG, there has been relatively little research on the appropriateness of the widely used 2–h plasma glucose level of 7.8 mmol/l (140 mg/dl) for defining IGT. The study by Gabir and others (2000) in Pima Indians showed that the risk of future diabetes increases gradually over most of the glucose distribution; however, the risk is markedly higher in the upper 10% of the glycemic distribution. The 5-yr incidence rate for new cases of diabetes was 24% for IGT compared to 4% in individuals with 2–h plasma glucose < 7.8 mmol/l. As reviewed in the section on 'normoglycemia', there is no consistent threshold for 2–h plasma glucose and adverse outcomes. Increasing 2–h plasma glucose levels across the diabetic and non-diabetic range are associated with the increased risk of fatal and non-fatal cardiovascular disease.

Cardiovascular events appeared to linearly increase with post-challenge plasma glucose in the non-diabetic range without a threshold (Levitan et al., 2005), or had a J-shaped relationship with the lowest observed death rates centered on 5.0 mmol/l for 2–h glucose for all-cause mortality and 6.0 mmol/l for coronary heart disease death. The DECODE study also reported a J-shaped relationship between all-cause and non-cardiovascular mortality and glucose with the lowest rates at a 2–h plasma glucose of 4.51–5.50 mmol/l, and a graded relationship between cardiovascular mortality and 2–h plasma glucose. Moreover, the Whitehall study showed that coronary mortality rose in a linear fashion from a 2–h blood glucose of 4.6 mmol/l (Brunner et al., 2006). In summary, although the data supporting the current 2–h plasma glucose value used to define IGT is limited, the current cut-point seems to be operationally adequate. However, it is important to note that the risk of future diabetes, premature mortality and cardiovascular disease begins to increase at 2–h plasma glucose levels below the IGT range. Since the rationale for this category is to define a risk state for future diabetes and/or future cardiovascular disease and premature mortality, a risk score combining known risk factors, which

includes a measure of glucose as a continuous variable, would seem a more logical approach.

It is clear that certain factors increase the risk of developing prediabetes and Type 2 diabetes. Researchers, however, still do not fully understand why the disease develops in some individuals, yet not in others. According to IDF, the following factors are considered to contribute to the disease development:

1. Obesity: It is a major health challenge in many developed countries, reaching global pandemic proportions. According to the Centres for Disease Control and Prevention, more than one-third of American adults and 17% of youth are obese. Obesity increases the risk of a number of health conditions, including high blood pressure, high cholesterol and Type 2 diabetes (Bcl10 Links).
2. If the Body Mass Index (BMI) greater than 25, the more fatty tissue, the more resistant cells become to insulin—regardless of which initiating event is proposed for Type 2 DM—obesity is an extremely important environmental influence. Approximately 80% of Type 2 DM is obese non-diabetic obese individuals exhibit insulin resistance and hyper-insulinemia. However, when obese patients with Type 2 DM are compared to weight-matched non-diabetics, it appears that the insulin level of diabetics is below these observed in obese non-diabetics, suggesting a relative insulin deficiency (Buchwald H.2009)
3. Inactivity: The less active individuals are at a greater risk of developing diabetes. Physical activity helps to control their weight, uses up glucose as energy, and makes cells more sensitive to insulin. Exercising less than three times a week as well as family history may thus increase the risk of Type 2 diabetes (Baker H.2007).
4. Race: Although it is unclear why, people of certain races (including African Americans, Hispanics, American Indians and Asians) are at higher risk as Centers for Disease Control and Prevention (CDC, 2011).
5. Age: Risk of developing diabetes increases with advancement of age, most likely due to decreased activity, loss of muscle mass and weight gain (CDC, 2011).
6. Sex: Young males are at higher risk than females in middle age (Kumar v). Although women are more affected because of pregnancy, in general gender does not play a role in DM prevalence (CDC, 2011).
7. Immune mechanism: Cell-mediated and human reaction against beta cells of pancreas is found in some diabetics, i.e. attack their own insulin-producing cells .

8. Diet: Recent studies suggest a connection between some trace elements, such as zinc and selenium, and DM
9. Behavior and stress: Lack of exercise alters the interaction between insulin and its receptors at the cellular level, causing stress that may bring about the disease (ADA ,2000)
10. Diseases: (a) viruses: rubella, mumps; (b) endocrine: in many instances, DM is secondary to disorders of endocrine glands as in acromegaly*, Cushing`s syndrome and thyrotoxicosis*.
11. Gestational diabetes: When gestational diabetes is developed in pregnancy, the risk of later developing prediabetes and Type 2 diabetes increases. A newborn weighing more than 9 pounds (4 kilograms) is also at risk of Type 2 diabetes.
12. A polycystic ovary syndrome: woman with polycystic ovary syndrome (a common condition characterized by irregular menstrual periods, excess hair growth and obesity) has a higher risk of diabetes.
13. High blood pressure: Blood pressure over 140/90 mm Hg is linked to an increased risk of Type 2 diabetes.
14. Abnormal cholesterol levels: Risk increases if levels of high-density lipoprotein (HDL), or "good" cholesterol are low, i.e. below 35 mg/dL.
15. High levels of triglycerides: If triglyceride levels are above 250 mg/dL, the risk of diabetes increases.
16. Early Diabetes Symptoms: The "classic" early diabetes symptoms are frequent urination, thirst, increased hunger, fatigue, and weight loss. Symptoms may vary or be hard to mark.
17. Smoking: Tobacco smoke contains about 400 chemical substances that may harm the body. Dr Carole Willi and his colleagues of the University of Lausanne in Switzerland conducted a study in which they explored the relationship between smoking and diabetes. The Swiss researchers found that smokers had a 44% higher chance of developing Type 2 diabetes compared to non-smokers. The risk was higher for heavy smokers. A number of studies also examined the association between smoking and incidence of glucose abnormalities. The findings reveal that smoking could be independently associated with glucose intolerance, impaired fasting glucose and Type 2 diabetes mellitus. Smoking causes diabetes because it leads to insulin resistance or inadequate compensatory insulin secretion responses. Thus, there is a 50% likelihood of increased risk for diabetes among smokers (in both men and women).
18. History of heavy drinking: Alcohol consumption can contribute to the conditions that cause diabetes. Extant evidence suggests that

heavy drinking can reduce the body's sensitivity to insulin, which can trigger Type 2 diabetes mellitus. Diabetes is a common side-effect of chronic pancreatitis, which is overwhelmingly caused by heavy drinking. Moreover, one in three individuals who have chronic pancreatitis will develop diabetes (Shah, 1987). Drinking can also increase chance of becoming overweight and therefore the risk of developing Type 2 diabetes.

CHAPTER THREE
Design and Methodology

3.1 Study Design

A cross sectional study (hospital based)

3.1.1 Exploratory Visits

Several meetings were held with authorities at ministry of health and regional council to facilitate examination and recruitment of study participants.

3.1.2 Pilot Study

Pilot study was conducted before the research commenced in order to estimate the needed time a patient would need to complete the questionnaire and to validate the questionnaire content.

3.2 Setting

Alkarak Hospital during the period of 5th February to 20th July, 2012

3.3 Participants and Sampling Methods

3.3.1 Target Population

The target population comprised of all diabetic patients aged 25 or above, who attended the Alkarak Hospital during the study period at Alkarak governorate in south Jordan.

3.3.2 Sample Size

Sample size was calculated based on OpenEpi, Version 2, open source calculator (Sample Size for Cross-Sectional, Cohort, & Randomized Clinical Trial Studies)

Table 3.1
Sample size formula and calculation

Two-sided significance level (1-alpha):	95
Power (1-beta, % chance of detecting):	80
Ratio of sample size, Unexposed/Exposed:	1
Percent of Unexposed with Outcome:	12
Percent of Exposed with Outcome:	36
Total Sample Size =	114

3.3.3 Sampling Frame

The total number of diabetic patients aged 25 or above that attended the hospital was 700, comprised of 280 males and 420 females.

The study participants were drawn from the above population and consisted of 47 males and 73 females, or 120 individuals in total.

3.4 Sampling Technique

1. Cross-sectional study approach was chosen to study some epidemiological patterns and risk factors of MS among diabetic patients in Alkarak region, using systematic simple random sampling (SSRS) method. All diabetic patients above 25 years old during the study period (five successive months), who attended Alkarak Hospital in south Jordan during the selected days (first five working days), were considered eligible to participate in this study.
2. Alkarak Hospital was visited 5 days in the week from 8 am until 3 pm. All eligible patients were given a pre-coded questionnaire to complete.
3. Anthropometric measurements were taken and full laboratory results were obtained by the investigator. The selected patients were considered as having MS or not, according to WHO classification.
4. Diagnostic criteria: MS was diagnosed using Adult Treatment Panel III (ATP III) criteria for the diagnosis of metabolic syndrome, based on the presence of three or more of the following medical disorders:

1. Abdominal obesity: waist circumference >102 cm (40 in.) in men and >88 cm (35 in.) in women.
2. High fasting glucose: serum glucose level >110 mg/dl (6.1 mmol/l) or on treatment for diabetes.
3. High blood pressure: SBP ≥130 and/or DBP ≥85 mmHg or on treatment for hypertension.
4. Hypertriglyceridemia: serum triglyceride level ≥150 mg/dl (1.69 mmol/l).

3.5 Methods of Data Collections

1. Medical records and medical reports
2. Standardized interviewer-administered questionnaire
3. Lab results
4. Anthropometric measurements: Weight, height and waist circumference were measured using standard equipments and according to the standard technique.

3.6 Statistical Design

Data were typed on to a personal computer using the Statistical Package of Social Science (SPSS) program version 16. Results were

considered significant if p-value was equal to or less than 0.05. EpiInfo was used to determine the sample size and calculate chi-square test, performed for simple comparison between frequencies.

3.7 Limitations of the Study

The nature of the study did not establish causal links but rather suggested an association between some characteristics of diabetic patients and their vulnerability to MS. Moreover, cross-sectional studies do not ascertain what comes first—the risk factor or the disease.

3.8 Study variables

3.8.1 Dependent variables

a. Diabetes mellitus
b. Metabolic syndrome
c. Impaired fasting glycaemia

3.8.2 Independent variables

a. Age
b. Sex
c. Education
d. Smoking
e. Marital status
f. Family income
g. Chronic diseases (hypertension, Hyperlipidaemia, hypercholesterolemia)

CHAPTER FOUR
FINDINGS, DISCUSSIONS, AND RECOMMENDATIONS

4.1 FINDINGS

4.1.1 Demographic characteristics of whole diabetics' respondents

Table 4.1 displayed the demographic characteristics of whole diabetics' respondents according to their age, education, marital and smoking status. The prevalence of DM was the highest among the age group (50-59) years old (34%), and the lowest prevalence was among the age group of 25-29 years old (4.2%), also, males were more than females with prevalence of 38.3% and 31.5% in the same age group, respectively, as shown in Table 4.1.

Table 4.1
Demographic characteristics and smoking status of whole diabetics' respondents aged ≥25 years according to sex

Variable	Male (n=47) n (%)	Female (n=73) n (%)	Total (N=120) N (%)	p-value*
Age				0.522**
25-29	2(4.3)	3 (4.1)	5(4.2)	
30-39	7(14.9)	12(16.4)	19(15.8)	
40-49	8(17)	22(30.1)	30(25)	
50-59	18(38.3)	23(31.5)	41(34.2)	
≥60	12(25.5)	13(17.8)	25(20.8)	
Education				0.019**
Illiterate	2(4.3)	12(16.4)	14(11.7)	
High school	25(53.2)	46(63)	71(59.2)	
Diploma	6(12.8)	7(9.6)	13(10.8)	
University	14(29.8)	8(11)	22(18.3)	
Marital status				0.05**
Married	44(93.6)	57(78.1)	101(84.2)	
Single	3(6.4)	11(15.1)	14(11.7)	
Widowed	3(0.0)	5(6.8)	5(4.2)	
Smoking status				0.021**
Smoker	16(34)	10(13.7)	26(21.7)	
Non-smoker	28(59.6)	60(82.2)	88(73.3)	
Ex-smoker	3(6.4)	3(4.1)	6(5)	

* Association is significant at the 0.05 level; **chi-square test

Being female and non-smokers were the highest category among smoking status respondents with prevalence of 82.2% compared to non-smoker males (59.6%).

According to the educational level, the DM prevalence was more in females more than males and the highest prevalence was among the high school class (59.2%).

Married respondent was the highest prevalence (84.25) compared to the widowed (4.2%).

4.1.2 The prevalence of metabolic syndrome (MS); impaired fasting glycaemia (IFG) and diabetes mellitus (DM) in Alkarak hospital

The total number of MS cases was 41 giving a prevalence of 34.2%, while subjects diagnosed as IFG = 541 giving a prevalence of 22.3%. The total number of DM cases (650) was obtained from the outpatient nutritional clinic at Alkarak general hospital; which give a prevalence of 21.1%, as shown in Table 4.2.

Table 4.2
Prevalence (number & percentage) of diabetic related disorders according to sex

Disease	**Number of cases**		**Total**	**Total population**		**Total**	**Prevalence (%)**		**Total**
	Male	Female		Male	Female		Male	Female	
Metabolic Syndrome	8	33	**41**	47	73	**120**	17	45.2	**34.2**
Impaired Fasting Glycaemia	227	314	**541**	1039	1389	**2428**	21.8	22.6	**22.3**
Diabetes Mellitus	289	361	**650**	1526	1552	**3078**	18.9	23.2	**21.1**

4.1.3 Metabolic characteristics and anthropometric measurements

The mean blood sugar level among total respondents was 209.78±97.05 (mg/dl), and males were more than females; however this difference was statistically not significant ($p=0.178$).

Table 4.3
Metabolic characteristics and anthropometric measurements for total respondents according to sex

Variable	Male (n=47) mean ±S.D.	Female (n=73) mean ±S.D.	Total (N=120) mean ±S.D.	p-value
blood sugar level (mg/dl)	224.68±105.98	200.19±90.28	209.78±97.05	0.178*
Weight (kg)	83.04±14.65	77.33±15.21	79.57±15.91	0.044*
Height (cm)	169.04±7.62	157.07±7.03	161.76±9.32	<0.001*
Waist circumference (cm)	98.28±13.35	99.55±16.72	99.05±15.44	0.662*
Body mass index (kg/m^2)	28.7±4.37	31.34±6.08	30.32±5.63	0.012*

*Independent sample t-test; Significant at the 0.05 level; S.D. = standard deviation

Also the waist circumference (cm) difference was not significant between males and females, however the differences in weight (kg), height (cm), and body mass index (BMI) were statistically significant between males and females with p-value of 0.044, <0.001and 0.012, respectively.

4.1.4 Gender differences in the MS occurrence

Table 4.4 displays the gender differences in the metabolic disorders occurrences, it is worth mentioning that MS, IFG, and DM were more prominent in females compared to males (45.2% vs. 17%, 22.6% vs. 21.8, and 23.2% vs. 18.9%, respectively).

MS was more prominent in females compared to males with prevalence of 45.2% and 17%, respectively, at Chi-square and (p-value) =10.09 (0.001); as shown in Table 4.4, 4.5.

Table 4.4
Prevalence (number & percentage) of MS according to sex

Disease	Number of cases		Total population		Prevalence (%)		Total
	Male	Female	Male	Female	Male	Female	
Metabolic Syndrome	8	33	47	73	17	45.2	34.2

Chi-square (p-value)=10.09 (0.001)*

Table 4.5
Distribution of respondents with metabolic syndrome according to sex

			Metabolic Syndrome No	Yes	Total
Gender	Female	Count	40	33	73
		%	54.8	45.2	100.0
	Male	Count	39	8	47
		%	83.0	17.0	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

Table 4.6 displayed the distribution of respondent with MS (yes) according to the educational status. The highest percentages were 42.9% and 46.2% among illiterate and diploma degree, respectively, the lowest percentage was among bachelor degree (13.6%).

Table 4.6
Distribution of respondents with metabolic syndrome according to educational status

			Metabolic syndrome No	Yes	Total
Educational Status	Bachelor	Count	19	3	22
		%	86.4	13.6	100.0
	Diploma	Count	7	6	13
		%	53.8	46.2	100.0
	Illiterate	Count	8	6	14
		%	57.1	42.9	100.0
	Tawjihi	Count	45	26	71
		%	63.4	36.6	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

Table 4.7 showed the distribution of respondents with metabolic syndrome according to their marital status. Widowed respondent was the highest percentage (60%) compared to the single and married respondents with MS.

Table 4.7
Distribution of respondents with metabolic syndrome according to marital status

			Metabolic Syndrome		Total
			No	Yes	
Marital Status	Married	Count	67	34	101
		%	66.3	33.7	100.0
	Single	Count	10	4	14
		%	71.4	28.6	100.0
	Widowed	Count	2	3	5
		%	40.0	60.0	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

Table 4.8 showed the distribution of respondents with metabolic syndrome according to the age category. The age category of 50-59 years and more than 60 years old were the highest percentages (41.5% and 44%, respectively), while the lowest percentage was among the age group of 25-29 years old (20%).

Table 4.8
Distribution of respondents with metabolic syndrome according to the age category

			Metabolic Syndrome		Total
			No	Yes	
Age Category (year)	25-29	Count	4	1	5
		%	80.0	20.0	100.0
	30-39	Count	14	5	19
		%	73.7	26.3	100.0
	40-49	Count	23	7	30
		%	76.7	23.3	100.0
	50-59	Count	24	17	41
		%	58.5	41.5	100.0
	>60	Count	14	11	25
		%	56.0	44.0	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

Table 4.9 showed the distribution of respondents with metabolic syndrome according to their smoking status. Ex-smokers were the highest percentage (50%).

Table 4.9
Distribution of respondents with metabolic syndrome according to smoking status

			Metabolic Syndrome		Total
			No	Yes	
Smoking Status	No	Count	55	33	88
		%	62.5	37.5	100.0
	Yes	Count	21	5	26
		%	80.8	19.2	100.0
	Ex-Smoker	Count	3	3	6
		%	50.0	50.0	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

Table 4.10 showed the distribution of respondents with metabolic syndrome according to BMI status. The obese respondents had the higher percentage (38.9%) compared to the non-obese respondents (16%).

Table 4.10
Distribution of respondents with metabolic syndrome according to BMI status

			Metabolic Syndrome		Total
			No	Yes	
BMI	Normal	Count	21	4	25
		%	84.0	16.0	100.0
	Obese	Count	58	37	95
		%	61.1	38.9	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

Table 4.11displayed the distribution of respondents with metabolic syndrome according to the presence of hypertension. Hypertensive respondents were 56% compared to the normal respondents without hypertension (21.1%).

Table 4.11
Distribution of respondents with metabolic syndrome according to the presence of hypertension

			Metabolic Syndrome		Total
			No	**Yes**	
Hypertension	No	Count	60	16	76
		%	78.9	21.1	100.0
	Yes	Count	19	25	44
		%	43.2	56.	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

Table 4.12 showed the distribution of respondents with metabolic syndrome according to the presence of hyperlipidemia. The percentage of respondents with hyperlipidemia was 74.15, while the respondent with normal lipid level was 1.5%.

Table 4.12
Distribution of respondents with metabolic syndrome according to the presence of hyperlipidemia

			Metabolic Syndrome		Total
			No	**Yes**	
Hyperlipidemia	No	Count	65	1	66
		%	98.5	1.5	100.0
	Yes	Count	14	40	54
		%	25.9	74.1	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

Table 4.13 portrayed the distribution of respondents with metabolic syndrome according to the presence of hypercholesterolemia. The highest percentage was among respondents with hypercholesterolemia (79.1%).

Table 4.13
Distribution of respondents with metabolic syndrome according to the presence of hypercholesterolemia

			Metabolic Syndrome		Total
			No	Yes	
Hypercholesterolemia	No	Count	70	7	77
		%	90.9	9.1	100.0
	Yes	Count	9	34	43
		%	20.9	79.1	100.0
Total		Count	79	41	120
		%	65.8	34.2	100.0

4.1.5 The effectiveness of educational intervention in the risk of developing MS among Alkarak population

Table 4.13 displayed the effect of interventional diet regime program for total respondents before and after implementation of the nutritional education program on the BMI, weight, blood sugar level, and waist circumference, respectively .

Table 4.14
Metabolic and anthropometric measurements before and after diet regime (paired t-test; pre-post test)

	Mean	Mean Difference	95% CI of Difference	t-test	P-Value
BMI before diet regime	30.3	1.142	0.90;1.37	9.63	<0.001
BMI after diet regime	29.2				
Weight before diet regime	79.6	3.083	2.55;3.61	11.5	<0.001
weight after diet regime	76.5				
Blood sugar level before diet regime	209.8	63.57	51.70;75.45	10.6	<0.001
Blood sugar level after diet regime	146.2				
Waist circumference before diet regime	99.0	3.85	3.17;4.54	11.1	<0.001
Waist circumference after diet regime	95.2				

BMI, weight, waist circumference, and blood sugar level were significantly decreased after implementation of the nutritional educational programme, with p<0.001.

4.1.6 DM complications

Table 4.14 portrayed that DM complications occurred in 76.7% of total respondents. The most common complications were fatigue, visual loss and feet numbness with a highest frequency rate of 61.7%, 46.5%, and 55.8, respectively.

Table 4.15

Diabetes mellitus related complications among whole respondents

	Complications	Presence	Number (n)	Percentage (%)
1	DM Complications	No	28	23.3
		Yes	92	76.7
2	Diabetic Coma-High Sugar Level	No	112	93.3
		Yes	8	6.7
3	Diabetic Coma-Low Sugar Level	No	105	87.5
		Yes	15	12.5
4	Fatigue	No	46	38.3
		Yes	74	61.7
5	Recurrent Inflammations	No	77	64.3
		Yes	43	35.7
6	Loss of Appetite	No	87	72.5
		Yes	33	27.5
7	Renal Failure	No	115	95.8
		Yes	5	4.2
8	Atherosclerosis	No	107	89.2
		Yes	13	10.8
9	Brain Stroke	No	112	93.3
		Yes	8	6.7
10	Peripheral Angiopathy	No	103	85.8
		Yes	17	14.2
11	Visual Loss	No	64	53.5
		Yes	56	46.5
12	Feet Numbness	No	53	44.2
		Yes	67	55.8
13	Feet Sores	No	99	82.5
		Yes	21	17.5
14	Anaemia	No	106	88.2
		Yes	14	11.8

4.1.7 Nutritional knowledge about diabetes mellitus among diabetic respondents

Table 4.15 displayed the respondents' nutritional knowledge about diabetes mellitus.

Table 4.16
Nutritional knowledge about diabetes mellitus among diabetic respondents

	Nutritional Knowledge	Presence	Number (n)	Percentage (%)
1	Care about food contents (sugar & fat)	No	91	75.8
		Yes	29	**24.2**
2	Care about food preparations (sugar & fat)	No	81	67.5
		Yes	39	**32.5**
3	Suitable foods for DM	No	81	67.5
		Yes	39	**32.5**
4	Number of meals per day	1	9	7.5
		2	19	15.8
		3	74	**61.7**
		4	12	10.0
		5	4	3.3
		6	2	1.7
5	Follow a diet regime for DM	No	58	48.3
		Yes	62	**51.7**
6	Believe that a diet regime improve health for diabetics	No	4	3.3
		Yes	116	**96.7**
7	Take foods with calcium	No	72	60.0
		Yes	48	40.0
8	Drink water regularly	No	34	28.3
		Yes	86	**71.7**
9	Eat olive oil	No	13	10.8
		Yes	107	89.2
10	Eat honey	No	96	80.0
		Yes	24	20.0
11	Eat fresh fruits regularly	No	83	69.2
		Yes	37	30.8
12	Eat fresh vegetables regularly	No	16	13.3
		Yes	104	86.7
13	Eat food with high sugar regularly	No	84	70.0
		Yes	36	30.0
14	Eat meat with low fat regularly	No	24	20.0
		Yes	96	**80.0**

Only 24.2% of study respondents they were care about food contents (sugar & fat), while 32.5% care about their preparations and recognize the

suitable foods for DM. About 62% of respondents get regular three meals per day compared to 7.5% who get their meal once a day. However, the percentage of respondents who follow a diet regime for DM were about 52%, and about 72% who drink water regularly.

4.1.8 Respondents' health education background and knowledge about DM

Table 4.16 demonstrated the respondents' health education background and knowledge about DM.

Table 4.17
Health education and background knowledge about DM among diabetics

		Opinion	Number (n)	Percentage (%)
1	did you think that health education reduced diabetic occurrence	Disagree	7	5.8
		Agree	112	93.3
		Neutral	1	0.8
2	did you think that drugs may leads to DM	Disagree	47	39.2
		Agree	48	40.0
		Neutral	25	20.8
3	did you think that obesity may leads to DM	Disagree	10	8.3
		Agree	106	88.3
		Neutral	4	3.3
4	did you think that DM is a contagious disease	Disagree	113	94.2
		Agree	4	3.3
		Neutral	3	2.5
5	did you think that psychogenic shock may leads to DM	Disagree	9	7.5
		Agree	105	87.5
		Neutral	6	5.0
6	did you think that chemicals and environmental factors may leads to DM	Disagree	52	43.3
		Agree	29	24.2
		Neutral	39	32.5
7	did you think that DM is a genetic disease	Disagree	17	14.2
		Agree	94	78.3
		Neutral	9	7.5
8	did you think that high sugar intake may leads to DM	Disagree	75	62.5
		Agree	40	33.3
		Neutral	5	4.2
9	did you think that stress may leads to DM	Disagree	12	10.0
		Agree	104	86.7
		Neutral	4	3.3

The percentage of respondents who agree that health education reduced diabetic occurrence was equal to 93.3%, about 88% of respondents think that obesity may leads to DM and agree that psychogenic shock and

stress may leads to DM. about 78% of respondents believe that DM is a genetic disease, while 14% of respondent were disagree with this belief.

4.1.9 Age onset of MS and DM in Alkarak population

Table 4.17 showed that mean age of MS was 52.98 years compared to non-cases (49.11), this difference in the mean age between cases of MS and non cases was borderline statistically significant at t-test = 1.79, p = 0.051. The mean age of diabetic patients was 50.43 years.

Table 4.18
Independent sample t-test for equality of means

Disease		N	Mean age (years)	Std. Deviation
MS	No	79	49.11	11.492
	Yes	41	52.98	10.506
DM	Yes	120	50.43	11.27

Table 4.18 displayed the distribution of the age onset of MS according to the age group. An ascending trend was observed for the age onset of MS, as the age increased the occurrence was increased dramatically, as the age group >60 years old = 44%.

Table 4.19
MS age onset according to the age group among whole respondents (n=120)

			Age groups (years)*					
			25-29	**30-39**	**40-49**	**50-59**	**>60**	**Total**
Metabolic Syndrome	No	N	4	14	23	24	14	79
		%	80.0	73.7	76.7	58.5	56.0	65.8
	Yes	N	1	5	7	17	11	41
		%	20.0	26.3	23.3	41.5	44.0	34.2
Total			5 100.0	19 100.0	30 100.0	41 100.0	25 100.0	120 100.0

*Ch-square = 4.57, p = 0.333

4.1.10 Relationship between BMI and DM (blood sugar level)

There was a linear relationship between the blood sugar level (mg/dl) and the BMI (kg/m2); as shown in Table 4.19. The final multiple linear regression equation can be displayed as follows:

$Y = a + b_1X_1 + b_2X_2 + \ldots b_nX_n$.

Blood sugar level (predicted) = 98.8 + 11.685× BMI.
a = Constant = 98.8.

Table 4.20
Factors Associated with blood sugar level (mg/dl) Using Multiple Linear Regression

Independent Variables	Constant	MLR [a] Adj. b [b]	95% CI	t	p
BMI	**98.8**	**11.68**	**4.26;19.11**	**3.117**	**0.002**

[a] Multiple linear regression (the model reasonably fits well; assumptions are met).
[b] Adjusted regression coefficient.
Dependent Variable: blood sugar level.

4.1.11 The effect of exercise therapy on MS

Table 4.20 portrayed the final logistic regression model (stepwise) for the relationship between MS and sports or practicing exercises regularly. The group of respondents who were not practicing exercises regularly was about 3.34 times more likely than exercise group to suffer from MS, as the Adjusted odds ratio (AOR) = 3.349 (Table 4.12).

Table 4.21
Factors associated with MS using multiple logistic regressions.

Variable		Adj. OR	95% CI OR	$\chi 2$ stat. (df)[a]	p–value[a]
Practicing exercise	No	3.349	1.065;10.535	5.11(1)	0.039
	Yes	1			

Adj. OR = Adjusted odds ratio; [a] Likelihood Ratio (LR) test.

4.1.12 Rrespondents' background characteristics and MS risk factors

Table 4.13 displayed that all potential risk factors of MS (Hypertension, Hyperlipidaemia and Hypercholesterolemia) were highly and significantly associated with the occurrence of MS. Marital status also showing an ascending trend for the risk of MS from widowed to married to single, however, this association was not significant. Educational status was inversely associated with the MS; as the educational status increased the chance to get MS was decreased, however this relationship was not significant statistically (table 4.21).

Table 4.22
Potential risk factors of MS and socio-demographic variables of respondents

		Metabolic Syndrome		Chi-square (p-value)
		No	Yes	
Hypertension	No	60(78.9%)	16(21.1%)	15.84
	Yes	19(43.2%)	25(56.8%)	(<0.001)
Hyperlipidaemia	No	65(98.5%)	1(1.5%)	69.5
	Yes	14(25.9%)	40(74.1%)	(<0.001)
Hypercholesterolemia	No	70(90.9%)	7(9.1%)	60.07
	Yes	9(20.9%)	34(79.1%)	(<0.001)
Smoking Status	No	55 (62.5%)	33(37.5%)	3.68 (0.159)
	Yes	21(80.8%)	5(19.2%)	
	Ex-Smoker	3(50.0%)	3(50.0%)	
Marital Status	Married	67(66.3%)	34(33.7%)	1.69 (0.43)
	Single	10(71.4%)	4(28.6%)	
	Widowed	2(40.0%)	3(60.0%)	
Educational Status	Bachelor	19(86.4%)	3(13.6%)	5.61 (0.132)
	Diploma	7(53.8%)	6(46.2%)	
	Illiterate	8(57.1%)	6(42.9%)	
	Thigh school	45(63.4%)	26(36.6%)	

4.2 DISCUSSIONS

Using the ATP III diagnostic criteria, we found that the overall prevalence of metabolic syndrome among total diabetic respondents was 34.2% (males
= 17% and females = 45.2%). IFG prevalence was 22.3%, and DM prevalence was 21.1%. This estimate was considerably higher than that described in the US population (24%, according to ATP III criteria) (Park et al., 2003). Also, a study done in Palestine showed that the prevalence of MS was 17%, according to WHO criteria) (Abdul-Rahim et al., 2001), and Omanis (21%, AT P III criteria) (Al-Lawati et al., 2003).

Our study findings were semi-comparable with the study of Jing et al., (2007) as the prevalence of MS was 38.2%, and IFG prevalence was 21.1%, however, the metabolic syndrome prevalence was high in IFG (38.1%) and DM was 48.7%. Other studies findings were similar to our study estimates like a study performed in a Turkey (33.4%, ATP III criteria) (Ozsahin et al., 2004), Iran (33.7%) (Azizi et al., 2003), and Asian Indian adults (41.0%) (Ramachandran et al., 2003).

These significant variations in the MS prevalence could be partly due to the combination of environmental and hereditary potential risk factors like decreased physical activity and increased BMI and obesity because of cultural and social restrictions. Newly adoption of sedentary lifestyle in Jordan may be an explanatory variable for the increased occurrence of MS, especially with increased age with female predominance; in addition to the pattern of fat distribution, and decreased insulin sensitivity in the late age (Carr et al., 2004).

The increasing prevalence in females as the age increased could be explained by the effect of menopause, which it is associated with increased insulin resistance, and accumulation of visceral fat (Fujimoto et al., 2000).

The mean blood sugar level (mg/dl), waist circumference (cm) and body mass index (BMI) among total respondents were more prominent among respondents with MS, and males were more affected than females. These results were consistent with another study performed in Iran, also, they concluded that males patient with MS were more educated compared to females, which means that females need to change their sedentary lifestyle (Abdoljalal Marjani and Ahmad Shirafkan, 2011).

Our study indicates that MS is highly prevalent in the elderly people particularly among women, which consistent with the study of Akbulut et al., (2011). Another study done by park et al., (2008) and Balkau et al., (2003) demonstrated that MS prevalence was more in females, however, Ford et al., (2002) concluded that there was no gender preferences in the MS prevalence. It is worth mentioned that MS prevalence in this study (34.2%) was less than other studies like in Isfahan (Iran) was 65.0% with higher rate in females than males, and the prevalence in Karachi (Pakistan) was 79.7% in type 2 diabetics (Imam et al., 2007).

However in diabetic Japanese (DM type 2), the prevalence of MS was less (26.3%) compared to the prevalence of this study (34.2%) (Yoshinori *et al.*, 2008). Our results were quite similar to a Korean study done by Kim et al., (2008); as their study results showed that MS among diabetic patients was 32.6%. The overall prevalence among Saudis with DM type 2 was 22.64% (19.49% male, 25.17% female) (Clin et al., 2010).

Females were more affected than males. This may be due to the specific characteristics in the lifestyle changes between females and males diabetic patients. The majority of females with MS were homemakers. It seems that they do less physical activity at home. In Iran, females in general do less physical activity and overweight and obesity were more obvious (Abdoljalal Marjani and Ahmad Shirafkan, 2011).

The prevalence of DM in this study was equal to 21.1%, which is less than a previous study conducted by the National Centre for Diabetes, Endocrinology and Genetics (NCDEG), which showed that 36% of Jordanians aged ≥25 years are diabetics. The prevalence of type 2 DM and

impaired fasting glycaemia (IFG) is elevated among Jordanian populations. More than 50% of the diabetic patients have unsatisfactory control (Ajlouni et al., 2008).

The prevalence rates of MS being the lowest in Somalia and the highest in Kuwait, as economic growth and urbanization have increased. Therefore, the movements of the populations to urban centers were highly encouraged, and they were likely to adopt new lifestyles that included high-calorie food consumption, these factors greatly contribute to the increased prevalence of obesity and diabetes in the Arabic countries (Badran et al., 1997).

The prevalence rate of MS is ranging from 19% to 45% as the prevalence of overweight and obesity (body mass index ≥25 kg/m2) has reached an alarming level in most countries of the middle east, mainly among females (Al-Sendi et al., 2003). A study on obesity and DM in Jordan obtained from findings from the 'behavioral risk factor surveillance system' estimates that about 50% of Jordanians do not engage in any physical activity (Zindah, 2007). Fritz et al., (2006) suggest that an increase of regular physical activity equivalent to 45 min of walking 3 days/week may suffice to improve lipid metabolism and BMI in patients with type 2 diabetes.

4.3 CONCLUSIONS

The overall prevalence of MS was 34.2%, while IFG prevalence = 22.3%. The DM prevalence was 21.1%. The prevalence of DM was the highest among the age group (50-59) years old (34%), and the lowest prevalence was among the age group of 25-29 years old (4.3%). According to the educational level and gender, the DM prevalence was more in females more than males and the highest prevalence was among the high school class (59.2%).

Married respondent was the highest prevalence (84.25) compared to the widowed (4.2%). Being female and non-smokers were the highest category among smoking status respondents with prevalence of DM = 82.2% compared to non-smoker males (59.6%).

The mean blood sugar level among total respondents in males was more than females; however, this difference was statistically not significant. Waist circumference (cm) and body mass index (BMI) were significantly higher in females compared to males. It is worth mentioning that MS, IFG, and DM were more prominent in females compared to males (45.2% vs. 17%, 22.6% vs. 21.8, and 23.2% vs. 18.9%, respectively).

BMI, weight, waist circumference, and blood sugar level were significantly lower after implementation of the nutritional educational programme. DM complications occurred in 76.7% of total respondents. The most common complications were fatigue, visual loss and feet

numbness. Mean age of MS was about 53 years old compared to non-cases (49 years old), and the mean age for diabetic patients was about 50 years old.

The multiple linear regression equation generated by the model is given by the expression: Blood sugar level (predicted) = 98.8 + 11.685× BMI. The result indicates that there is a significant linear relationship between BMI (kg/m2) and blood sugar level, whereby for every increment of one unit in BMI, the blood sugar level will increase by 11.68 (mg/dl) (95% CI = 4.26;19.11(mg/dl)).

The final model of logistic regression revealed that, the group of respondents who were not practicing exercises regularly was about 3.34 times more likely than exercise group to suffer from MS, as the Adjusted odds ratio (AOR) = 3.349.

4.4 RECOMMENDATIONS

1. Recommendations for Weight Loss:

a. Weight loss recommended for all overweight or obese individuals at risk

b. Begin a structured program emphasizing lifestyle changes, including moderate weight loss, and regular physical activity (150 min/week) with dietary strategies, including reduced calories and reduced intake of dietary fat.

c. Limit intake of sugar-sweetened beverages.

2. Recommendation for all with diabetes mellitus:

a. Attain and keeps the best result including, control blood glucose in the normal range or as close to normal to prevent complications of DM,

b. Avoid and cure the development of chronic complications of DM by modifying nutrient intake and life style to prevent obesity, and improve health through healthy food choices and physical activity.

c. Focus in patient nutritional needs, taking into consideration personal and cultural preferences and lifestyle.

3. Recommendations for medical nutrition therapy:

a. Encourage weight loss for all overweight and obese individuals

b. Monitor carbohydrate consumption to achieve glycaemia control.

c. Customize nutrition counselling to each patient.

d. An educational program that emphasizes lifestyle modification with importance of adherence to treatment regimen would be of great benefit in glycaemic control.

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Appendix (I):
Questionnaire

استبيان لدراسة انتشار مرض السكري في محافظة الكرك

الرقم المتسلسل:---------------------- التاريخ:----------------------

<u>أولا : معلومات شخصية</u>

الاسم: .... الجنس: (ذكر ، أنثى) تاريخ الميلاد:..............
الطول ؟ .... الوزن ؟ .... محيط الخصر ....
المهنة: .... الدخل الشهري: ....

المستوى التعليمي: ....

طبيعة العمل : (مكتبي ، ميداني"يحتاج الوقوف لفترات طويلة ، غير ذلك "حدد ....")

الحالة الاجتماعية: ....

مكان السكن : .... عدد أفراد الأسرة ....

هل تدخن السجائر: (نعم ، لا ، مدخن سابق ، غير ذلك "حدد..............")

عدد السجائر التي تدخنها يوميا: ....

هل تدخن الأرجيلة: (نعم ، لا) إذا كانت الإجابة نعم كم مرة تدخنها في الأسبوع؟ ....

هل أنت مؤمن صحيا : (نعم ، لا) جهة التأمين الصحي ....
هل أنت عضو في الجمعية الأردنية لمرضى السكري: (نعم ، لا)

هل تعاني من أي أمراض أخرى (التاريخ المرضي): (نعم ، لا)

إذا كانت الإجابة نعم حددها: ....

<u>ثانيا : معلومات صحية</u>

1) منذ متى تعاني من مرض السكري (تاريخ التشخيص): ....

2) نوع مرض السكري : أ) النوع الأول

ب) النوع الثاني

ج) أخرى ، حدد ....

3) العلاج الذي تستخدمه :

ا) الحمية الغذائية
ب) الرياضة
ج) أقراص بالفم حبوب oral hypoglycemic agents
د) حقن أنسولين

و) أخرى ، حدد ....
4) هل تتناول العلاج بانتظام حسب إرشادات الطبيب:

(دائما ، أحيانا (حسب الحاجة) ، أهمل به ، لا)

5) مستوى السكر لديك طيلة فترة الإصابة : ا) مضبوط جيدا
ب) متذبذب
ج) سيء
د) غير ذلك ، حدد ....

6)هل لديك احد من أفراد الأسرة يعاني من مرض السكري (نعم ، لا)

إذا كانت الإجابة نعم حدد عدد المصابين...
7) **هل تعاني من أي من المضاعفات التالية ؟**

أ) قرحة بالقدم (نعم ، لا)
ب) خدران و نمنمة في القدمين (نعم ، لا)

ج) ضعف في البصر (نعم ، لا)
د) مرض الأوعية الدموية الطرفية (نعم ، لا)

هـ) ارتفاع ضغط الدم (نعم ، لا)
و) جلطة بالدماغ (نعم ، لا)

ز) تصلب الشرايين (نعم ، لا)

ح) هبوط / فشل كلوي (نعم ، لا)

ط) فقدان الشهية (نعم ، لا)

ي) التهابات متكررة(نعم ، لا)

ك) هل تعاني من التعب بدون سبب واضح (نعم ، لا)

ل) هل تتعرض لغيبوبة هبوط السكر (نعم ، لا) عدد المرات ....

م) هل تتعرض لغيبوبة ارتفاع السكر (نعم ، لا) عدد المرات ....

<u>ثالثا : التثقيف الغذائي</u>

<u>1)هل تملك جهاز لقياس السكري؟ (نعم ، لا)</u>

2) هل تعمل على قياس السكر في الدم (نعم ، لا) كم مرة في اليوم ....

3) هل تعاني من ارتفاع الدهون (نعم ، لا) نسبته في الدم ....
4)هل تعاني من ارتفاع الكولسترول (نعم ، لا) نسبته في الدم ....
5) هل تعاني من فقر الدم (نعم ، لا) نسبته ....
6) كم وجبة تتناول في اليوم ....
7) ما هي أكثر الأصناف الغذائية أو الأطعمة التي تتناولها يوميا:

(خضروات ، لحوم ، نشويات،أخرى(حددها..

8) هل تنظر إلى الأطعمة الغذائية قبل شرائها وتقرأ محتواها من السكر أو الدهن أو الملح:

(نعم ، لا)

9) هل تهتم بطريقة إعداد الطعام في المنزل؟

مثلا: تتابع محتواه من الزيت أو السكر أو الملح

10)هل تعرف ما الغذاء المناسب لمريض السكري؟

11)هل تتبع حمية غذائية مناسبة لمريض السكري؟

12) هل تقلقك الحمية الغذائية وتجعلك تخاف من الحرمان من تناول ما تحب؟

13) هل تعتقد ان الحمية تساعد في تحسين حالتك الصحية؟

	نعم	لا	عدد المرات / يوم	عدد المرات / اسبوع
1) هل تمارس الرياضة بانتظام ويوميا؟				
2) هل تحرص على تناول وجبة الإفطار؟				
3) هل تتناول العسل ؟				
4) هل تتناول زيت الزيتون ؟				
5) هل تحرص على شرب الماء بانتظام ؟				
6) هل تحرص على تناول الكالسيوم (الحليب) ؟				
7) هل تتناول الحليب الكامل الدسم ؟				
8) هل تتناول الخضروات الطازجة أو المجمدة ؟				
9) هل تتناول الفواكه الطازجة باستمرار؟				
10) هل تحب شرب عصير الفواكه وتفضله على تناول الفاكهة نفسها ؟				
11) هل تتناول السكريات و الحلويات ؟				
12) هل تتناول المشروبات الغازية باستمرار، وهل تكون عادية أم خالية من السعرات؟				
13) هل تتناول الوجبات السريعة (المطاعم) باستمرار؟				
14) هل تتناول الدجاج المنزوع الجلد واللحم منزوع الدهن ؟				
15) هل تتناول المقالي باستمرار ؟				
16) هل تحرص على تناول المأكولات البحرية ؟				
17) هل تعاني من أمراض متعلقة بالغذاء مثل فقر الدم أو القرحة وغيرها ؟				
18) هل تجري فحص طبي دوري، لنقل مرتين في السنة؟				

رابعا: للنساء المتزوجات فقط

1) كم عمرك عند زواجك ؟ ....

2) كم كان وزنك عند زواجك ؟ ....

3) هل لديك أطفال ؟ ....

إذا كانت الإجابة نعم، حددي عددهم وجنسهم وأعمارهم...................................

4) عند حملك كم تكون في العادة الزيادة في الوزن لديك؟ ....

5) كم يكون وزن أطفالك عند ولادتهم؟ ....

6) هل حدث وأصبت بالسكري في فترة حملك؟ (نعم ، لا)

7) في أي شهر من الحمل تم اكتشاف السكري؟ ....

8) ما العلاج الذي قمت باستخدامه خلال فترة حملك؟ ....

9) هل استخدمت الأنسولين للعلاج خلال فترة حملك؟
10) هل تمارسين الرياضة أثناء الحمل؟ (نعم ، لا)

ما نوعها ومن نصحك بها ؟ ....

خامسا:المعرفة

	أوافق	لا أوافق	محايد
1) التوترات النفسية والعاطفية قد تؤدي للإصابة بالسكري			
2) تناول الأطعمة المحتوية على السكر السبب الوحيد للإصابة بالسكري			
3) الوراثة من الأسباب الرئيسية التي تؤدي للإصابة بالسكري			
4) العوامل البيئية مثل التعرض للكيماويات والفيروسات تؤدي للإصابة بالسكري			
5) يحدث السكري نتيجة لصدمة نفسية أو عصبية			
6) السكري مرض معدي ينتقل من شخص إلى آخر			
7) الزيادة في الوزن أو السمنة تزيد من احتمالية الإصابة بالسكري			
8) بعض العقاقير الطبية قد تؤدي للإصابة بالسكري			
9) معدل الوعي الصحي لدى الأفراد عن مرض السكري يقلل من الإصابة			
10) الأشخاص الذين يمارسون أساليب غير صحية كالخمول تزيد احتمالية إصابتهم بالمرض			
11) الفحص الدوري للسكر في الدم يساعد على التقليل من احتمالية الإصابة بالسكري			

1) هل تفكر في تغيير نمطك الغذائي لتحسين صحتك (نعم ، لا)
2) عادة غذائية سيئة تتبعها وتفكر في تغييرها ....

....
3) ما رأيك في التثقيف الغذائي في مجتمعنا وهل هو كافي أم يحتاج للمزيد ....

....

4)هل أصابك إحباط لدرجة انه لا يهمك ما يحدث من مضاعفات؟.......................

شكرا لحسن تعاونكم

الاسم.................. التوقيع................

المعلومات الشخصية

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الكلية: العلوم

القسم: الاحياء

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